DEVELOPING FIRE PREVENTION INSPECTION SKILLS USING COMPUTER BASED TRAINING

Strategic Management of Change

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ABSTRACT

This research project analyzed the use of fire department developed Computer Based Training (CBT) programs to provide skills learning to company fire inspectors. The purpose of the research was to determine whether a computer based training programs could be delivered cost effectively, efficiently, and be readily accepted by the firefighter students.

This research employed evaluative research to (a) determine whether the fire department could develop CBT inspection skills training programs, (b) identify whether CBT can provide skills training at a lower cost that conventional training methods, and © determine whether CBT is an accepted method of skills training by company fire inspectors.

The primary procedural methods were to research existing materials on delivery of training using computers, develop and evaluate actual CBT titles, and to review and assess their impact on the fire inspection training programs of the department. The research findings were utilized to determine whether the department should continue or expand development and delivery of a computer based training programs.

The major findings of the research suggested that multimedia training programs can be developed cost effectively by fire department trainers, the training is easy to use, and learning by computers is viewed as a good method of skills enhancement by students. Additional findings included a perception by students that they learned more using the CBT approach and that they retained more using the computer approach than with traditional classroom training.

The recommendations resulting from this research included continuing CBT as a delivery method for fire prevention training and development of additional courseware for other subjects specific

to firefighting and emergency medical services.

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Introduction

The Bellevue Fire Department has long recognized the organizational value in conducting routine fire prevention inspections by on-duty firefighters. In order to maintain a high level of inspection competency, the department has historically provided monthly fire prevention inspection training to all firefighters. This training has generally been viewed as costly to conduct, difficult to maintain student interest, and often disrupted by emergency responses.

The format used to provide fire prevention inspection training was a traditional lecture presented by a prevention division inspector. Classes were conducted on a monthly basis by members of the fire prevention division and were delivered in the fire stations based on a schedule developed by the departments Fire Prevention and Training Divisions.

The purpose of this research project was to determine whether fire department developed computer based training programs could effectively be used to deliver fire inspection skills for firefighters.

The research procedure was evaluative in nature and conducted to determine whether computer based training programs could be developed using existing department resources and whether this level of training was more or less efficient than existing methods. In addition, the acceptance of firefighters for this type of training was evaluated to determine the effectiveness of the presentation method.

BACKGROUND AND SIGNIFICANCE

The Bellevue Fire Department is an urban department serving a population of approximately 130,000 residents in the Pacific Northwest. Bellevue is a retail hub of the region and, as a result, is home to a considerable number of mercantile and office occupancies. The fire department has identified approximately 8,000 business occupancies which require annual inspection. Although the department maintains a full service fire prevention division, the resources within the fire prevention program are not sufficient to assign every occupancy to a regular fire prevention inspector. As a result, the department has developed a company inspection program which assigns some occupancies to fire stations based upon their proximity to the station and the significance of the identified hazard. Nearly 5,000 or 60% of all routine inspections are conducted by firefighting personnel in the Bellevue system.

The department has struggled to provide adequate levels of inspection or code training to firefighters. Since fire inspection duties are only a part of the overall assignment of a Bellevue firefighter, inspection training represents only a fraction of the total training package delivered to employees. Each month, fire prevention division inspectors would be assigned a prevention skill's topic for the month for which they would develop a lesson plan. Inspectors would then contact each company officer to schedule a prevention class sometime during the month. The combination of shift work and the inability to assemble all personnel into a single location required the delivery of approximately 20 classroom presentations in order to reach all personnel. Other complexities which were encountered included alarm activity which resulted in classes being abruptly interrupted, vacation schedules which resulted in missed training, and the difficulty in maintaining active participation in a subject which by the firefighters own admission is not the most entertaining.

In late 1996, the Fire Prevention Division began to investigate possible alternative opportunities. The department was interested in finding a method which would provide the training efficiently, at a relatively low cost, and provide high levels of retention. The department discovered that a recent city wide management training program had identified computer based training as a potential cost effective and efficient method for providing skills-based learning (MCTP, 1996). Although untested, the report reflected that a Bellevue firm, Asymetrix Corporation, was a leading provider of computer based training developer software. Contact was made with Asymetrix and after review, the software product was purchased to allow for in-house development of computer based training modules.

It was decided that a year long study would be conducted during 1997 to determine whether the use of CBT could be reasonably produced by Bellevue personnel and whether it would result in efficiencies and delivery of cost effective training.

The significance of this project to the Bellevue Fire Department lies in the need to provide quality fire prevention inspections by firefighting personnel to maximize their effectiveness and to satisfy a primary goal of the department to reduce fire loss. Although existing training provided regular training opportunities, it was not cost effective nor an efficient method of training delivery.

The research is directly related to the National Fire Academy course, Strategic Management of Change since the use of CBT is relatively new concept and likely to provide a significant transformation in the way training is delivered throughout the fire service.

LITERATURE REVIEW

The literature review began by conducting research on the use of Computer Based Training (CBT) applications currently in use by Fire Departments. Unfortunately, materials which directly relate to fire department applications are almost non-existent. This suggests that few, if any, fire or emergency service organizations are not equipped to develop or regularly use CBT type materials. The primary focus of the literature review was then redirected to a more global analysis of CBT principles and concepts.

The use of CBT is not a new concept. Training by computer began as far back as the 1970's, when the Chrysler Corporation launched computer-controlled interactive video disks to teach skills to assembly line workers (Field, 1997). CBT has been described as "any training that uses a computer as the focal point for instructional delivery. With CBT, training is provided through the use of a computer and software, which guides a learner through an instructional program" (Bixler, 1997).

CBT can be extremely cost effective. While customized computer-based training programs can be very expensive, off-the shelf and "customizable" programs can run as little as \$20 to \$100, and enrolling employees in computer-based learning labs can run as little as \$30 to \$50 per credit hour (Bixler, 1997). One of the more efficient aspects of CBT is that after initial costs, you have a 24 hour per day trainer. Additionally, by using CBT a trainer can teach any number of trainees at the same time. By customizing CBT programs to focus only on what trainees need to learn, training time and costs can be significantly reduced. Finally, CBT may enable you to reduce or eliminate travel for trainees, your total training costs can also be lessened (Bixler, 1997).

Perhaps the most solid data regarding the difference between multimedia training and traditional classroom training is that multimedia CBT saves time - anywhere from 25-50% with most reports showing a 35-45% decrease in training time. (Allen, 1997). In a 1990 review of more than 40 different studies in industry, education, and the military, Fletcher (1990) found that across all studies, approximately 31% savings in time was achieved when multimedia training was compared to equivalent classroom instruction. (Allen, 1997).

Another identified difference between CBT and classroom instruction is the improved instructional reception by the students. Adams (1992) reviewed six case studies that carefully compared multimedia training to classroom instruction. Learning gains were up to 56% greater and content retention was 25-50% higher (Adams, 1992).

One of the most useful aspects of CBT is that trainees work at their own pace. CBT can sequence training to match the trainee's needs, schedule, and location. This is particularly important to fire service learning since training can often be interrupted by emergency calls. By utilizing a CBT environment, students can access the training when it best fits their particular schedule, not the schedule of the training officer.

The effectiveness of CBT for adult learners is based upon the fact that students feel in control. The computer is nonjudgmental and non-threatening. It provides a privacy factor that reduces learners' embarrassment about taking "remedial" classes or making mistakes while answering questions in the training materials (Bixler, 1997). The computer actively engages the trainee in the training process, providing increased trainee satisfaction. In an in-depth study of six corporate case studies, Hall discussed significant improvements in motivation of learners, their ability to retain what they learn longer

and more accurately, and actual performance improvements on the job attributable to the training. (Hall, 1995). Hall concludes that "there is very strong evidence that computer based training results in an equal or higher quality of learning over traditional instruction" (Hall, 1995).

From a fire department management perspective, CBT provides increased control over training activities. It provides management systems for tracking trainees' progress and a consistency of training in terms of quality and information presented. CBT provides standardization of training when training occurs in several work locations or by several instructors. This is particularly beneficial to a fire service environment which often has multiple work locations and shift schedules which result in only a portion of the work force being on-duty at the same time.

Computer Based Training is not however the answer to every training need (Allen, 1997). It is more appropriate in some situations than others. For example, CBT is not a great solution for teaching skills that involve lots of "hands-on" activity such as touching and using equipment. The computer does not do a great job of observing someone perform interpersonal skills (i.e., nonverbal behavior) and then providing specific, corrective feedback. Multimedia training has been shown to be very effective, however, in preparing people to safely use equipment by teaching components, functions, hazards, or processes' people need to know before they touch the equipment (Allen, 1997).

PROCEDURES

The desired outcome of this research was to evaluate whether an alternative method of fire prevention inspection instruction could be developed using computer based training. The research was evaluative in nature since a new fire inspection training system was analyzed and measured to determine whether it met the needs of the department. The data gathered was based on the actual experiences of the individuals involved in the training development and by students who utilized the computer based system.

The criterion for which the system was to be evaluated was divided into two separate components. First, could the development of specific training programs using computer based technology be developed in-house, using existing resources and still maintain a cost-effective method of development and delivery. Second, would computer based skills training be accepted by the end users.

The development of the computer based training programs was based on the use of a software development program, *Toolbook Instructor*, by Asymetrix Corporation of Bellevue, Washington. The program is designed to created interactive courses for delivery by a variety of mediums, including network, CD-Rom and Internet based. It was determined that subject matter would be identified and that a course would be developed and delivered to the nine Bellevue fire stations at the beginning of each month. The courses were designed so that every member of the operations division (160 personnel) could log into the course by providing their name and the system would then track their progress and report scores. Company officers were responsible for making certain that each member

of their company completed the course on a monthly basis. The department had recently installed identical multimedia capable desktop computers in each fire station, resulting in easy access for all department members to the training. The courses would be developed within the fire prevention division based upon subject matter specific to Bellevue.

The department felt that it was important to determine whether the development and delivery of the training was cost effective. Since inspection skills enhancement had previously been developed and delivered using traditional classroom presentation methods, it was decided to compare the cost of the more traditional method versus a computer based training approach.

The evaluation of the program by the end users (80 randomly selected personnel) was detailed by a survey which was presented in an interactive computer format at the conclusion of the year long study. Students were asked nine specific questions (Appendix A) relating to their perceptions of the training and whether they felt it had provided a good mechanism for fire prevention inspection skills improvement.

There was one limitation noted in this process which was an indication whether the computer based training method provided better retention and skill development compared to a more traditional classroom approach. It was determined that this issue would require a separate study which took into account test scores and field evaluation of actual personnel involved. However, any evidence which might be gathered during personal observations or program critiques should be utilized as an evaluative tool to determine whether the delivery method should be continued.

RESULTS

Answers to Research Questions

Research Question 1. Can the Bellevue Fire Department develop Computer Based Fire
Inspection Training programs without the assistance of programming professionals?

The ability to develop CBT programs by non-programming professionals is directly proportional to the computing skills of the staff, combined with the flexibility and ease of use of the software. Significant software advancements have been made over the past three years making CBT development easier and more accessible to the actual trainer, not just a software programmer. Historically, CBT titles were created by a specialized cadre of professionals who were trained in the art of multimedia software development, including the use of audio, visual and graphic media. In addition, CBT software required the use of programming language or scripting expertise. Today, several products have entered the market which allows the trainers to develop creative and professional looking courseware quite efficiently without the need for high level programmers.

The department selected *Toolbook Instructor 5.0* based upon its ease of use, combined with the fact that the company was located in close proximity to the agency and would facilitate a quick response to any software questions. Toolbook was designed to allow non-programmers to create learning courses using predefined "widgets" and "specialists" which allow the developer to "drag and drop" components of the courseware. By adding specific information or course content, the staff member was able to develop a course which included sound, photos, text and interactive questions and learning exercises designed to provide a stimulating and challenging learning exercise. Each month, a course was created which included course content and associated learning exercises. At the conclusion

of each course, a quiz or test was presented to test the knowledge of the student of the material which were presented.

Table 1
CBT Course Title and Development Time

	*	
Month	Course Title	Development Time
January	Exits and Egress	30 Hours
February	Occupancy Types	30 Hours
March	Inspection Roles	24 Hours
April	General Fire Safety	20 Hours
May	General Fire Safety Part II	20 Hours
June	Fire Investigation	18 Hours
July	Fire Lane Enforcement	15 Hours
August	Emergency Plans	12 Hours
September	General Inspections	18 Hours
October	Reports and Records	10 Hours
November	Occupancy Change of Use	10 Hours
December	Yearly Review and Test	5 Hours*

^{*} The final course development was a compilation of previous courseware which resulted in less development time.

The department was able to create eleven learning modules during 1997 (Table 1). They included CBT courses on general code knowledge, common fire hazards, fire lane enforcement, fire investigation practices, and fire code administration. Each module contained basic course content information supplemented by learning exercises and usually followed by a course quiz. There was

obvious improvement in both the content, look and feel of each course as experience was gained in utilizing the software.

The first course developed, "Exits and Egress Principles" took nearly 30 hours of development time to create and distribute. The final course was completed in approximately one-third of that time, or about 10 hours. In addition, the course content improved each month to include more visual, audio and animation activities which stimulated interest by the students.

<u>Research Question 2.</u> Do Computer Based Training programs deliver inspection skills development at a lower cost than traditional training delivery methods?

The total cost of development and delivery of computer based training appears to be completed at a lower cost than the traditional method of classroom presentation. In order to effectively evaluate the true costs, the development cost was added to delivery costs and compared against the development and delivery cost traditional classroom methods.

The development cost of each program is reflected in Table 2 and is reflective of the time associated with development of each course title. As suggested earlier, the amount of time necessary to develop each course tended to become shorter as expertise was developed in using the *Toolbook Instructor* software. Since the developer was generally a manager within the Fire Prevention Division, the hourly salary rate is higher than traditionally associated with fire prevention personnel but lower than could be anticipated with a professional programmer typically used for this type of software development.

Table 2
COMPUTER BASED TRAINING COST - 12 MONTH PROGRAM

Month	Course Title	Development Hours	Development Cost	Delivery Cost	Total
January	Exits and Egress	30 Hours	\$1080.00	\$80.00	\$1160
February	Occupancy Types	30 Hours	\$1080.00	\$80.00	\$1160
March	Inspection Roles	24 Hours	\$864.00	\$80.00	\$944
April	General Fire Safety	20 Hours	\$720.00	\$80.00	\$800
May	General Fire Safety Part II	20 Hours	\$720.00	\$80.00	\$800
June	Fire Investigation	18 Hours	\$648.00	\$80.00	\$728
July	Fire Lane Enforcement	15 Hours	\$540.00	\$0	\$540
August	Emergency Plans	12 Hours	\$432.00	\$0	\$432
September	General Inspections	18 Hours	\$648.00	\$0	\$648
October	Reports and Records	10 Hours	\$360.00	\$0	\$360
November	Occupancy Change of Use	10 Hours	\$360.00	\$0	\$360
December	Yearly Review and Test	5 Hours	\$180.00	\$0	\$180
Totals		192 Hours	\$9,252.00	\$480.00	\$9,732

In addition, since the department was not capable of using high speed network connections between stations, monthly courses were loaded on each of the nine fire station computers and remained resident on the hard drives. This necessitated a monthly software installation at each station which could be eliminated with a wide area network

The costs associated with the more traditional classroom delivery method of training were estimated based upon previous experience (Table 3). These costs were broken down into components

which represented instructor preparation and course delivery. Since each course required the attendance of the instructor, the delivery costs were much higher than those experienced with computer based training.

Table 3
ESTIMATED TRADITIONAL TRAINING COSTS 12 MONTH PROGRAM

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Month	Course Title	Development Hours	Development Cost	Delivery Cost	Total
January	Exits and Egress	5	\$150	\$1187	\$1337
February	Occupancy Types	5	\$150	\$1187	\$1337
March	Inspection Roles	5	\$150	\$1187	\$1337
April	General Fire Safety	5	\$150	\$1187	\$1337
May	General Fire Safety Part				\$1337
	П	5	\$150	\$1187	
June	Fire Investigation	5	\$150	\$1187	\$1337
July	Fire Lane Enforcement	5	\$150	\$1187	\$1337
August	Emergency Plans	5	\$150	\$1187	\$1337
September	General Inspections	5	\$150	\$1187	\$1337
October	Reports and Records	5	\$150	\$1187	\$1337
	Occupancy Change of	5	\$150	\$1187	\$1337

December	Yearly Review and Test	5	\$150	\$1187	\$1337
Totals		60	\$1800	\$14,244	\$16044

<u>Research Question 3</u>. How will Computer Based Training be received by firefighters charged with the responsibility of conducting fire prevention inspections.

The acceptance of the computer based training format was excellent based upon a survey of system participants. There were 80 individuals from program participants randomly surveyed regarding nine specific questions. The nine questions were given to the participants in a computer based format and students were allowed to answer each question by agreeing or disagreeing with the statement. The range of answers which could be selected included strongly agree; agree; neutral; disagree; and strongly disagree.

Survey Question 1 - "I learned more from using the fire prevention computer based training than I did when it was provided by classroom lecture."

The general response to this question was positive with 65% of the respondents indicating either a strongly agree or agree answers. The remainder of the participants were neutral (33%) and the remaining 2% either disagree or strongly disagreed with the statement. This suggests that the majority of the students using the CBT training system felt they learned more from using the computer based system than they did when it was provided in the traditional classroom setting.

Survey Question 2 "The computer based fire prevention training resulted in better retention

of the material than when I read the code book alone."

The overwhelming response to this question was strongly positive, with more than 77% of the students suggesting they had better material retention using the CBT modules than when the studied the code book alone.

Question 3 "I participated in all computer based training modules presented during 1997."

Nearly 98% of the respondents indicated they had participated in all of the CBT training modules presented during 1997. It is interesting to note that participation was essentially mandatory and the company officer was responsible for ensuring that all members of their platoon completed the training during the prescribed time frame. This question was relevant to those individuals who may have been on disability leave for extended periods and unable to participate. However, the CBT modules were maintained on the individual station computers and course could be made up at any time.

Question 4 "I considered the computer based training format easy to use."

100% of the students indicated that the CBT format was easy to use by providing a strongly agree or agree answer. This is particularly interesting since not all participants were regular users of the computer and, in fact, for some students the use of the CBT modules was the primary introduction into the regular use of desktop systems.

Question 5 "I learned more about fire prevention this year using the computer based training method than I have in other years."

Approximately 55% agreed that they learned more about fire prevention this year by using the CBT method than previous years using other types of training medium. However, it is noteworthy that nearly 44% either were neutral in their response or disagreed.

Question 6 "The computer based training program was the first time that I used the computer on a regular basis."

The majority of the respondents disagreed with this statement suggesting that most had used fire station computers prior to being introduced to the CBT program. Nearly 30% did suggest that they either agreed or were neutral to the statement suggesting that CBT exercises provided the first real exposure to the fire station computer.

Question 7 The training was appropriate for my level of fire prevention expertise."

The lessons were considered skill appropriate by approximately 77% of the students. Most of the remaining students were neutral (12%) with a smaller segment (11%) responding that the training was not appropriate for their level of expertise. The question did not provide an analysis for whether the training was either too elementary or too advanced.

Table 4
CBT Participant Survey

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	20%	46%	32%	1%	1%
2	35%	42%	18%	4%	1%
3	46%	44%	8%	1%	1%
4	46%	53%			1%
5	19%	37%	27%	16%	1%
6	6%	12%	12%	41%	29%
7	20%	57%	12%	9%	2%
8	27%	50%	18%	4%	1%

9 49% 40% 10% 1%

Question 8 "I would like to see other types of fire training conducted using computer based training."

Nearly 80% of the respondents indicated that they would like to see other types of fire training conducted using computer based training. Most of the remainder of the students (18%) were neutral with a small segment responding with disagreement with other types of CBT training.

Question 9 "I would prefer that computer based fire prevention training is continued during 1998."

More than 90% of the students polled indicated they were in agreement that CBT be used for fire prevention training in 1998. There was only one respondent indicating disagreement with using CBT for fire prevention training in 1998.

DISCUSSION

The results of the study suggest that CBT development can be accomplished with existing Bellevue Fire Department resources, at a cost lower than associated with more traditional training and is well received by those using a computer based training format. These findings correlate well to those studies which have been conducted on the use of CBT.

One of the more enlightening discoveries was that nonprofessional programmers can produce CBT courseware with minimal training and a relatively small investment. Within just the past two years, courseware has been developed which allows individuals to create dynamic, professional looking CBT titles within a reasonable development time cost. For example, courses developed toward the end of the year long Bellevue Fire Prevention Division study was requiring as few as 10 hours of development time but producing instructional capacity similar to the delivery of 18 classes of two hours each. In addition, the courseware remains available to future students without the need for an on-site instructor or facilitator.

It is likely that the use of CBT within the fire service will expand dramatically over the next several years as more and more departments recognize the availability of easy-to-use software combined with the efficiency of the CBT delivery system. Government is looking for increased capacity and increased efficiency without a corresponding increase in expenditures.

One of the most beneficial aspects of CBT appears to be the acceptance that firefighters had for the program. There was a highly positive response to the training system which is consistent with other studies conducted in the field.

RECOMMENDATIONS

The Bellevue Fire Department should continue to utilize CBT as a delivery method for fire prevention training and should consider expanding courseware to include more subjects specific to firefighting and emergency medical services. The industry seems to be moving toward a system which provides a "just in time" learning environment which allows for almost immediate delivery of CBT titles on a specific skill subject. For example, if the department were to discover an improved method for hoseline advancement, a specific CBT title could be developed to demonstrate the procedure which includes video demonstration, course content reinforcement and reinforcement in the form of student exercises. It would be particularly beneficial for those with the institutional knowledge of the process to be included in the development of the CBT title.

A continuing review should take place to ensure that CBT development continues to be cost effective and provide the appropriate level of training to the student.

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